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Maritimes Region

Proceedings of the Regional Assessment of Nova Scotia (4VWX) Snow Crab (*Chionoecetes opilio*, O. Fabricius)

February 24, 2015
Dartmouth, Nova Scotia

Chairperson: Kristian Curran
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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

Snow Crab (*Chionoecetes opilio*, O. Fabricius) is a subarctic species with a distribution from northern Labrador to near the Gulf of Maine. Habitat preference is soft mud bottoms. The Snow Crab fishery on the Scotian Shelf has been in existence since the early-1970s. The last assessment of Nova Scotia (4VWX) Snow Crab was undertaken on February 25, 2014 (DFO 2014). Fisheries and Oceans Canada (DFO) initially planned for a Snow Crab fishery update in 2015; however, due to a change in research survey vessel it was decided that a full assessment would be undertaken. As such, a Snow Crab assessment science advisory meeting was held February 24, 2015, at the Mic Mac Boatclub, Dartmouth, Nova Scotia. The Snow Crab science lead, Mr. Adam Cook, reviewed the 2014 fishery and survey. Co-presenter Dr. Jae Choi also provided input into the discussion. The discussion focused on various aspects of the Working Paper, including: size; biomass; migration; bycatch; and predator/prey interactions. Meeting participants then reviewed the Science Advisory Report section-by-section; much of the discussion focused on North-Eastern Nova Scotia. In general, meeting participants felt the Working Paper presented sound scientific analyses based on the best available information on Snow Crab, and is acceptable for publication as a Research Document pending revision following discussions of the meeting. In addition, there was support for publication of the proposed Science Advisory Report provided edits discussed at the meeting were adopted in the report's final format. The Science Advisory Report received consensus at the meeting.

Compte rendu de l'évaluation régionale du crabe des neiges (*Chionoecetes opilio*, O. Fabricius) en Nouvelle-Écosse (4VWX)

SOMMAIRE

Le crabe des neiges (*Chionoecetes opilio*, O. Fabricius) est une espèce subarctique présente dans les eaux qui s'étendent depuis le nord du Labrador jusqu'aux environs du golfe du Maine. Ses habitats de prédilection sont les fonds vaseux mous. La pêche du crabe des neiges est pratiquée sur le plateau néo-écossais depuis le début des années 1970. La dernière évaluation du crabe des neiges en Nouvelle-Écosse (4VWX) a été réalisée le 25 février 2014 (MPO 2014). À l'origine, Pêches et Océans Canada (MPO) avait prévu faire le point sur la pêche du crabe des neiges en 2015, mais, en raison d'un changement des navires de recherche, on a décidé d'effectuer une évaluation complète. Ainsi, une réunion de consultation scientifique pour l'évaluation du crabe des neiges a eu lieu le 24 février 2015 au Mic Mac Boat Club à Dartmouth, en Nouvelle-Écosse. M. Adam Cook, responsable scientifique pour le crabe des neiges, a passé en revue la saison de pêche et le relevé de 2014. M. Jae Choi, Ph. D. et coauteur, a également fait part de ses commentaires lors de la discussion. La discussion portait sur divers aspects du document de travail, y compris ; la taille, la biomasse, la migration, les prises accessoires et les prédateurs/proies. Les participants à la réunion ont ensuite examiné l'avis scientifique section par section. La majeure partie de la discussion mettait l'accent sur le nord-est de la Nouvelle-Écosse. En général, les participants étaient d'avis que le document de travail présentait des analyses scientifiques rigoureuses fondées sur les meilleurs renseignements disponibles sur le crabe des neiges, et qu'il peut être publié en tant que document de recherche en attendant sa révision à la suite des discussions durant la réunion. En outre, ils ont donné leur accord quant à la publication de l'avis scientifique proposé, sous réserve que les modifications abordées lors de la réunion soient adoptées dans la version définitive du rapport. L'avis scientifique a fait l'objet d'un consensus au cours de la réunion.

INTRODUCTION

Snow Crab (*Chionoecetes opilio*, O. Fabricius) is a subarctic species with a distribution from northern Labrador to near the Gulf of Maine. Habitat preference is soft mud bottoms. Smaller crabs are found in more complex habitats with shelter. Commercial crab (male, >95 mm carapace width; CW) in large numbers are found at depths from 60 m to 280 m and temperatures from -1°C to 6°C on the Scotian Shelf Ecosystem (SSE). Snow Crab has been a dominant macro-invertebrate in the SSE since the decline of groundfish during the late-1980s and early-1990s. The SSE Snow Crab are in the southern-most extreme of their spatial distribution in the Northwest Atlantic. The Snow Crab fishery in eastern Canada began in 1960 with incidental bycatches by groundfish draggers near Gaspé, Quebec. Its development was slow until the 1980s, when it began expanding rapidly to become one of the largest fisheries in Canada in terms of landings and landed value. On the Scotian Shelf, the fishery has been in existence since the early-1970s. The last assessment of Nova Scotia (4VWX) Snow Crab was undertaken on February 25, 2014 (DFO 2014).

Fisheries and Oceans Canada (DFO) initially planned for a Snow Crab fishery update in 2015; however, due to a change in research survey vessel it was decided that a full assessment would be undertaken. As such, a Snow Crab assessment science advisory meeting was held February 24, 2015, at the Mic Mac Boatclub, Dartmouth, Nova Scotia. The overall objectives of the meeting were to:

- Assess the overall status of 4VWX Snow Crab stocks as of the end of the 2014 season;
- Evaluate the consequences of different harvest levels during the 2014 fisheries on stock abundance and exploitation rate;
- Report on the bycatch of non-target species in the Snow Crab fishery in 2013 and identify any notable changes in the occurrence of these bycatch species relative to previous years; and
- Describe any relevant predator/prey interactions.

The meeting Chair-person, Mr. Kristian Curran, first introduced himself, followed by an introduction of meeting participants (Appendix 1). The Chair thanked meeting participants for attending the DFO Science Advisory Process. The Chair provided a brief overview of the Canadian Science Advisory Secretariat (CSAS) science advisory process and invited participants to review the meeting Terms of Reference (Appendix 2) and Agenda (Appendix 3). No revisions or additions were made to the Terms of Reference or Agenda. To guide discussion, a Working Paper was provided to meeting participants on November 28, 2014, in advance of the meeting date. This Proceeding constitutes a record of meeting discussions and conclusions.

PRESENTATION AND DISCUSSION

Rapporteur: Kristian Curran

PRESENTATION OF WORKING PAPER

Regional Oceanography and Temperature

Presenter: David Brickman

David Brickman, a physical oceanographer and ocean circulation modeller with DFO, gave a presentation on the physical oceanography (i.e. temperature, circulation, ice, etc.) of the Scotian Shelf and adjacent waters, as well as forecasts of potential conditions that might be expected in the future. Dr. Brickman noted that the North Atlantic Oscillation (NAO) index was in a high period in 2014, similar to that observed in 2012 when very high water temperatures in the region were observed; he noted that both years have shown significant anomalies in warmer than usual sea bottom temperatures. In contrast, Dr. Brickman noted that wind stress observed in 2014 was generally normal – 2014 was a break from recent years of drastically less sea ice. Since around 2005, above average sea surface temperatures have generally been observed in the region.

A meeting participant inquired as to what was being observed on the water this winter. Dr. Brickman commented that bottom temperature was colder than last year, although understanding of how the ocean functions in the region may have a large random component resultant of intermittent jets of warm or cold water eddies that periodically enter the region (e.g. Warm Core Rings from the Gulf Stream). The meeting participant then asked how frequently modeled runs could be produced for the region, and Dr. Brickman indicated that modeled output on the order of a month is presently available. The discussion then turned to anticipated future ocean conditions in the region. Dr. Brickman indicated that his ocean model run for ocean temperature provides slightly different answers than climate models, and tends to be less drastic over the long-term. Dr. Brickman noted, however, that modeled temperature outputs remain pessimistic in terms of suitable thermal habitat for Snow Crab in the region over the long, but that the model can be re-run with improved knowledge of Snow Crab thermal tolerance if available.

Status of the Snow Crab Fishery and Survey (2014)

Presenter: Adam Cook

The Snow Crab science lead, Dr. Adam Cook, reviewed the 2014 fishery and survey. Co-presenter Dr. Jae Choi also provided input into the discussion. The discussion focused on various aspects of the Working Paper, including: size; biomass; migration; bycatch; and predator/prey interactions.

Size

Meeting participants noted that survey results over the last few years have shown relatively small amounts of softshell crab versus earlier years. It was asked if the mean size of crab in the trawl survey matches up with Observer results, and the presenter noted that Observer results might be influenced by being on vessels that are targeting areas with larger crab (which could skew the data). It was suggested that the Working Paper include variation/standard deviation about Snow Crab sizes to see what the size range might be. It was also noted that the fishery takes a lot of the CC4 crab out of the population, so you do not see many of them showing up in

the paper's figures. Similarly, CC5 crab does not trap very well, and are often not observed in the trawl survey.

A question regarding mating season was asked by a meeting participant, and the presenter indicated that Snow Crab mating generally occurs in the late winter/early spring. The meeting participant subsequently asked if pushing the fishing season earlier in the year impacts mating, and it was noted that it might, but that males generally have the opportunity to mate before the fishing season begins. Further, there does seem to be a large amount of small crab around, which suggests recruitment is happening (little crab are showing up in the fall index survey). It was further noted that North-Eastern Nova Scotia (N-ENS) crab seemed to be bigger in 2012 than 2014, based on sections from the processor. The discussion turned to sex ratio, with the presenter noting that a high sex ratio can be bad for the stock in general, although a low sex ratio can also be bad. Meeting participants asked what an ideal sex ratio would be, and the presenter responded that optimally the population would be skewed such that there are more males given their increased size offers some protection to females.

Biomass

The discussion focused on the new survey vessel used for the most recent survey. The presenter noted that the new vessel is comparable to the previous survey vessel, and the same survey approach was used this past year (e.g. same net, captain, crew, speed, etc.). As such, no correction factor was applied to this year's survey results. Survey results indicated that N-ENS continues to exhibit biomass decline (in contrast, a 4X harvester noted that there are still lots of Snow Crab coming up in the traps). A representative of the N-ENS fishery noted that biomass estimates for the north fail to recognize efforts undertaken prior to 2005, as the survey does not give the whole picture given much of the bottom is not suitable for the trawl survey. In addition, the representative noted that Snow Crab catches in the north were higher in the past, but when effort in the DFO Gulf region increased, along with increased effort in South-Eastern Nova Scotia (S-ENS), catches in the north have seemingly decreased significantly. Last, it was discussed that catch rate data might also be informative, although it was recognized that there are a lot of factors that influence catch rate. It was concluded that the main indicator of biomass remains the trawl survey. Although the survey does not provide detailed information for each fishing hole it does yield the best overall picture of the stock. If there is interest from industry to have an additional survey in the spring/summer it could be discussed, although viability of such a survey would be contingent on the availability of additional resources.

Migration

There was discussion on Snow Crab migration, particularly between N-ENS and adjacent areas in the Gulf of St. Lawrence. The presenter indicated that the survey is only undertaken in the fall, so it is not possible to quantify seasonal migrations. The presenter did note that he would like to include movement data in the future based on acoustic and spaghetti tagging research that is on-going. A reviewer noted that tagging work that has begun, if expanded, could yield more information about migration between areas. A representative of the N-ENS fishery noted that the Working Paper identified a 3400 tonne biomass estimate of CC2 for last year that is now absent; he questioned if this could be the result of migration. The presenter responded that last year it is very possible the bulk of the fishery was provided by crab migrating into and out of the area. The presenter noted again that DFO is trying to use a tagging study to evaluate movement between N-ENS and the Gulf of St. Lawrence, although the Department is only receiving approximately 6% tag returns. It was further noted that Snow Crab science is done differently between the DFO Gulf and DFO Maritimes regions, and better communication between the two regions would be of benefit.

Bycatch and Predator/Prey Interactions

The presenter noted that in general bycatch was extremely low this past year versus previous years, although more bycatch was observed in 4X this past year compared to previous years. It was noted that in 4X harvesters had to search more for crab this past season, so fished in different areas where there was more diversity of fish. No data on seal consumption was included in the Working Paper. There is anecdotal evidence, however, that seals are consuming Snow Crab, so information on this would be informative. There is also anecdotal evidence that Cod may be eating Snow Crab, although currently-available data does not support this supposition.

Reviewer Thoughts

Peer reviewers felt the Working Paper was very thorough, scientifically sound, and well done. There were some minor questions regarding Observer data and how the biomass index was calculated (the final document will clarify the method), although it was agreed the minor comments would be forwarded to presenter for incorporation into a revised paper prior to its finalization and publication as a Research Document.

REVIEW OF THE SCIENCE ADVISORY REPORT

Presenter: Adam Cook

Meeting participants reviewed the Science Advisory Report section-by-section; much of the discussion focused on N-ENS. Some meeting participants re-iterated their view that although the early fishery has reduced the amount of softshell Snow Crab being caught, a concern remains that the animals still are not able to mate. In addition, concerns were also raised that Snow Crab are not as full when they are caught earlier. In response, a co-presenter indicated that the present stock consists of approximately 20% females, so in order for mating to be impacted a significant number of males would need to be impacted by the fishery to have an effect on overall mating success. Further, every mature female observed in the survey had eggs, suggesting that they are being fertilized. On this point, it was noted that it would be worth mentioning in the reproduction section of the report that there is zero fishing mortality for the female crab population. Last, it was asked why an increase in biomass was not observed following a fishery change aimed at reducing capture of softshell crab in N-ENS. It was noted recruitment might not be showing up in the fall survey.

Additional questions on Snow Crab larval drift and migration were discussed. The presenter indicated that larval drift generally has not been assessed given it is difficult to study. That being said, it was also noted that in the past few years no females have been observed in the survey despite increases in biomass, suggesting that drift into the area may be important in some years. In terms of migration, it was noted that approximately 3400 tonne of crab appear to be 'missing' year-over-year from CC2 (not showing up in the CC3 the following year). The presenter noted that the trawl survey does not take into account migration into or out of the area during times not covered by the survey, although acoustic tags along the 22/23 line could provide some insight into the migration of Snow Crab proximal to the Glace Bay Hole. It was clarified that crab are not 'missing', rather are just not being seen in N-ENS. It was asked if expanding the existing tagging program could answer some of these questions, and the presenters indicated that this could be done provided the tags were returned. The presenter did indicate, however, that the resources required to address the migration of N-ENS Snow Crab would be significant, with the question of migration still remaining difficult to address from a scientific point of view.

It was agreed that a survey in July used to account for when the crab are actually present might be useful. The co-presenter noted, however, that although there may be one year where there appears to be something different in the data in N-ENS, what is being observed remains within the potential statistical error for the survey. Thus, the survey generally speaking, tracks what is being observed in the fishery quite well. In addition, survey station density is far higher in N-ENS, so to get a better handle on Snow Crab migration in this area there would need to be more resources allocated to modelling. It remains that undertaking a trawl survey while the commercial trap fishery is occurring would be challenging, and the vessel that does the survey might be fishing commercially, so a survey at a time of the commercial fishery might be disruptive to the individual's fishing viability.

Issues regarding offshore petroleum seismic, illegal catch, and St. Anns Bank Marine Protected Area (MPA) area of interest were discussed. Anecdotal evidence suggested that during past seismic activity migration of Snow Crab into Glace Bay Hole appeared to cease for 3-4 years following a program conducted in the vicinity of Sydney Bight. Members of the fishing community believed the program directed females into shallower water, impacting both recruitment and migration in the area. In terms of illegal catch, members of the fishing community noted that with Snow Crab being easy to catch, and of higher monetary value than in the past, it is essential that adequate oversight of the fishery be carried out. It was suggested that illegal catch is an issue, emphasizing a need for DFO Conservation & Protection to have a presence on the water to combat misreporting, under reporting, and illegal landings. In absence of sufficient levels of oversight, to allow illegal catch to continue unchecked would undermine the good work being done to ensure that sustainable quotas are established. Last, meeting participants noted that the potential benefit to Snow Crab stocks of designating St Anns Bank as an MPA remains to be seen, so requested that the Science Advisory Report characterize the St. Anns Bank MPA area of interest as has having a "potentially positive" impact on Snow Crab rather than stating a "positive" impact, as was written in the draft report presented at the meeting.

In general, meeting participants felt that the Science Advisory Report was well-written and suitable for publication. The Science Advisory Report received consensus at the meeting.

CONCLUSIONS

Meeting participants felt the Working Paper presented sound scientific analyses based on the best available information on Snow Crab, and is acceptable for publication as a Research Document pending revision following discussions of the meeting. There was also support for publication of the proposed Science Advisory Report provided edits discussed at the meeting were adopted in the report's final format. Sincere efforts were made in this science peer review process to acknowledge and address all comments and concerns raised by meeting participants provided they were appropriate and within the confines of acceptable peer review practice. The Science Advisory Report received consensus at the meeting.

REFERENCES CITED

DFO. 2014. Assessment of Nova Scotia (4VWX) Snow Crab. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/033.

APPENDICES

APPENDIX 1: LIST OF MEETING PARTICIPANTS

Name	Affiliation
Amablio, David	Crab Fishermen's Association
Anderson, Bob	CFA 24 (S-ENS)
Bernard, Patricia	Waycobah Fisheries
Boutilier, Randy	Snow Crab
Brickman, Dave	DFO Maritimes / Ocean and Ecosystem Science Division (BIO)
Butler, Maureen	DFO Maritimes / Resource Management
Cameron, Brent	DFO Maritimes / Population Ecology Division (BIO)
Choi, Jae	DFO Maritimes / Population Ecology Division (BIO)
Coffen-Smout, Scott	DFO Maritimes / Oceans & Coastal Management
Cormier, Paul	CFA 23 (S-ENS)
Cook, Adam	DFO Maritimes / Population Ecology Division (BIO)
Couture, John	Unama'ki Institute of Natural Resources
Curran, Kristian	DFO Maritimes / Centre for Science Advice
Donovan, Darrell	CFA 23 (S-ENS)
Green, Kevin	N-ENS Snow Crab
Hubley, Brad	DFO Maritimes / Population Ecology Division (BIO)
Kaiser, Blair	CFA 24 (S-ENS)
Kehoe, Paul	CFA 24 (S-ENS) / CORE
MacDonald, Gordon	CFA 23 (S-ENS)
MacMullin, Neil	Crab Fishermen's Association
Martin, Tim	Native Council of Nova Scotia
McIntyre, Tara	DFO Maritimes / Population Ecology Division (BIO)
McMahon, Mike	DFO Maritimes / Population Ecology Division (BIO)
Murphy, David	CFA 24 (S-ENS)
Nasmith, Leslie	DFO Maritimes / Population Ecology Division (BIO)
Nolan, Bobby	CFA 23 (S-ENS)
Organ, Greg	N-ENS Snow Crab
Penny, Lorne	DFO Maritimes / SWNS Area Office
Smith, Allen	4X Snow Crab
Smith, Colleen	DFO Maritimes / Policy & Economics
Symes, Stanley	CFA 23 (S-ENS)
Vascotto, Kris	Nova Scotia Department of Fisheries & Aquaculture
Wheaton, Thomas	DFO Maritimes / Population Ecology Division (BIO)

APPENDIX 2: MEETING TERMS OF REFERENCE

Assessment of Nova Scotia (4VWX) Snow Crab

Regional Peer Review - Maritimes Region

February 24, 2015
Dartmouth, Nova Scotia

Chairperson: Kristian Curran

TERMS OF REFERENCE

Context

Snow crab has been a dominant macro-invertebrate in the Scotian Shelf Ecosystem (SSE) since the decline of the groundfish. They are observed in large numbers in deep, soft-bottom substrates ranging from 60-280 m water depths and at temperatures generally less than 6°C. Snow crab in this area is in the southern-most extreme of its spatial distribution in the Northwest Atlantic. The snow crab fishery has been in existence in Nova Scotia since the early 1970s. It occurs annually throughout the year dependent upon the Crab Fishing Area (CFA). In support of the fishery, DFO Maritimes Fisheries and Aquaculture Management Branch has requested that DFO Science Branch assess the status of the resource and consequences of various harvest levels for the coming fishing season. The last assessment of snow crab was conducted in February 2014 (Cook et al. 2014; DFO 2014)

Objectives

The objectives for this science advisory assessment meeting are:

- Assess the overall status of 4VWX snow crab stocks as of the end of the 2014 season using the following indicators:
    - Abundance
        - Snow crab survey biomass index of males greater than 95 cm (commercial sizes)
    - Recruitment
        - Snow crab survey R-1 relative abundance
    - Exploitation Rate
        - Incidence of CC5 crab in the survey
        - Relative exploitation rate from the survey
    - Report on
        - Commercial catch rates in the 2013 fishery, compared to those in previous years
        - Abundance of female crab from the survey
- Evaluate the consequences of different harvest levels during the 2014 fisheries on stock abundance and exploitation rate.
- Report on the bycatch of non-target species in the snow crab fishery in 2013 and identify any notable changes in the occurrence of these bycatch species relative to previous years.
- Describe any relevant predator/prey interactions.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Participation

- DFO Maritimes Science
- DFO Maritimes Fisheries and Aquaculture Management
- Provincial Government representatives
- Industry
- Aboriginal Organizations
- Environmental Non-government Organizations
- Other

References

DFO. 2014. Assessment of Nova Scotia (4VWX) Snow Crab. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/033.

Cook, A. M., Zisserson, B.M., Cameron, B.J. and Choi, J.S. 2014. Assessment of Scotian Shelf Snow Crab in 2013. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/052. vi + 101 p.

APPENDIX 3: MEETING AGENDA

Assessment of Nova Scotia (4VWX) Snow Crab

Regional Peer Review - Maritimes Region

February 24, 2015
Dartmouth, Nova Scotia

Mic Mac Amateur Aquatic Club
192 Prince Albert Road
Dartmouth, Nova Scotia

Chairperson: Kristian Curran

DRAFT AGENDA

08:30 – 0900	Welcome and Introduction (Chair)
09:00 – 09:45	Oceanographic Conditions on the Scotian Shelf (D. Brickman)
09:45 – 10:30	The 2014 Snow Crab Fishery and Survey
10:30 – 10:45	Health Break
10:45 – 12:00	Scotian Shelf Snow Crab Assessment
12:00 – 12:30	Examination by Reviewers
12:30 – 13:30	Lunch (Compliments of Area 23 Crab Fishermen's Association)
13:30 – 14:00	Examination by Reviewers (continued)
14:00 – 15:00	General Discussion (Chair)
15:00 – 15:30	Review of Science Advisory Report
15:30 – 15:45	Health Break
15:45 – 16:45	Review of Science Advisory Report (continued)
16:45 - 17:00	Chair closing